Chapter 10
System Analysis

10-1. Plan Evaluation

a. Plans for reducing flood damage are comprised of one or more type of measures. For example, a mix of channel modifications, detention storage, floodproofing, regulatory policies, and flood-warning preparedness may be one plan for reducing flood damage throughout the study area. Another plan may have similar mixes of measures but is sized differently and may be used at different locations. Other plans may be completely different sets of measures and actions. The plan formulation and evaluation process is summarized in Chapter 2 and discussed in detail in ER 1105-2-100.

b. The total economic accomplishment, performance, and environmental impact of a flood damage reduction plan is not simply the sum of the output of the individual measures. Instead, a well-formulated plan can yield greater benefit, perform better, and have less adverse impact through synergism. For example, if land-use regulation is combined with a reservoir, the flow regulations will reduce damage susceptibility and the size of a reservoir may be reduced. Consequently, the same damage reduction may be achieved at less cost and, perhaps, with less adverse environmental impact. This interaction means that the components of a plan cannot be formulated and evaluated independently. Instead, the interdisciplinary planning team must view a flood damage reduction plan as a system and must evaluate explicitly the interactions of the measures. These interactions will affect the economic benefit performance, and environmental impact of the plan.

10-2. Economic-Objective Evaluation for System

a. The impact of interaction of plan components can be illustrated with the example in Figure 10-1. For this example, development upstream has led to increased runoff that in turn, causes flood damage downstream. The planning team has proposed a channel modification to reduce the downstream stage and corresponding damage. Based on engineering judgment and experience, several alternative sizes and configurations were proposed. In response to concern over the environmental impact of excavation required for larger channels, an upstream detention storage basin also has been proposed. This detention basin, configured as shown, reduces the flow to the channel, thus reducing the required capacity and the

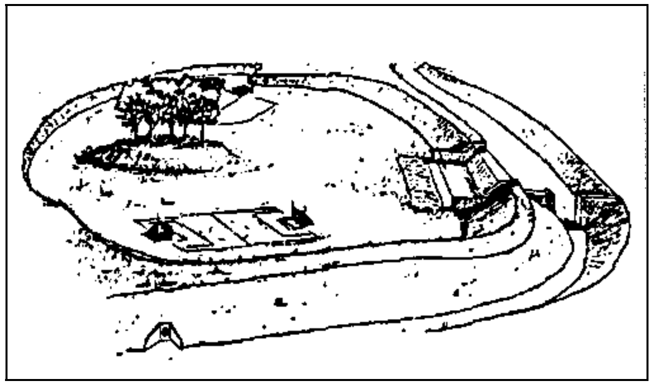

Figure 10-1. Example of flood damage reduction system (from drawing furnished by U.S. Army Engineer District, Tulsa)

necessary excavation. Again based on engineering judgment and experience, several alternative sizes and configurations were proposed for the detention basin.

b. To e valuate the net benefit of each alternative, the interaction of the channel and the detention basin must be considered explicitly, since the channel impacts the stage-discharge function and detention storage impacts the discharge-frequency function. To do so systematically, a decision tree like that shown in Figure 10-2 might be constructed to identify the plans. In this illustration, four channel sizes and configurations are formulated; these are labeled C1, C2, C3, and C4. Three detention storage alternatives, labeled D1, D2, and D3, are proposed. Each branch in the decision tree represents an alternative plan with one of the proposed channel configurations and one of the proposed detention storage alternatives. Evaluation of the with- and without-project conditions

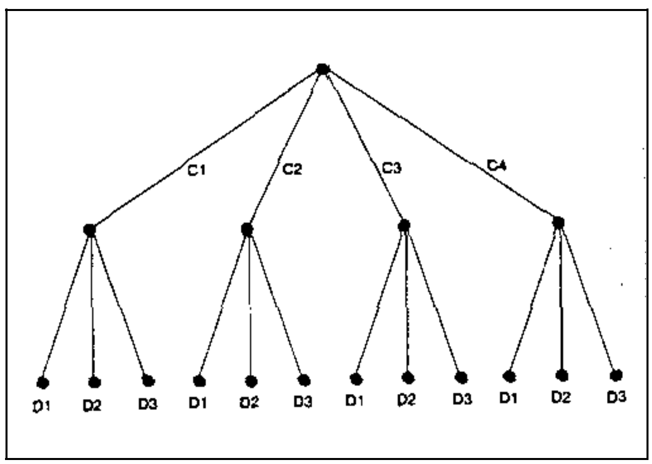

Figure 10-2. Decision tree for system of Figure 10-1

frequency and stage relationships using procedures are described in Chapter 2. The expected annual damage analyses are performed as illustrated in Figure 2-1.

c. The hydrologic engineering studies must identify both planned and incidental changes to the discharge-frequency, stage-discharge, and stage-damage functions. Table 10-1 summarizes both for various flood damage reduction measures described in this manual, but the list is not universal. A careful analyst will consult the Corps laboratories and experienced staff for help with identifying interactions in unusual circumstances.

Table 10-1
Impacts of Flood Damage Reduction Measures

	Impact of Measure		
Measures	Modifies discharge-frequency function	Modifies stage-discharge function	Modifies stage-damage function
Reservoir	Yes	Maybe, if stream and downstream channel erosion and deposition due to change in discharge occur	Maybe, if increased development in floodplain occurs
Diversion	Yes	Maybe, if channel erosion/deposition due to change in discharge occur	Maybe, if increased development in floodplain occurs
Channel improvement	Maybe, if channel affects timing and storage is altered significantly	Yes	Not likely
Levee or floodwall	Maybe, if floodplain storage is no longer available for flood flow	Not likely	Yes
Floodproofing	Not likely	Not likely	Yes
Relocation	Not likely	Maybe, if flow obstructions are removed	Yes
FW/P plan	Not likely	Not likely	Yes
Land-use and construction regulations	Not likely	Maybe, if flow obstructions are removed	Yes
Acquisition	Not likely	Maybe, if flow obstructions are removed	Yes